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AMRDEC HIGH LEVEL ARCHITECTURE TRANSITION

Timothy K. McKelvy
Gregory B. Tackett
Systems Simulation and Development Directorate
Aviation and Missile Research, Development, and Engineering Center

and

Kathryn J. Roose
Simulation Technology (SIMTECH), Inc.
3307 Bob Wallace Ave.
Huntsville, Alabama 35805

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Aviation and Missile Research, Development, and Engineering Center
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ABSTRACT (CONT)

The RDE community has been reluctant to transition their legacy DIS assets to a HLA framework, even with the improvements and enhancements to the Real-Time Platform Reference Federation Object Model. This reluctance has persisted in spite of some inherent limitations in the DIS standards for simulation developers and analysts. Many creative and ingenious methods have been developed to address some of these limitations, but these solutions have rarely been published and offered to the simulation community for reuse.

This report presents an overview of several extensions to the Institute of Electrical and Electronic Engineers (IEEE) DIS standards derived to meet the data collection needs of the Rapid Force Projection Initiative Advanced Concept and Technology Demonstration (RFPI ACTD) Field Experiment. This effort, jointly conducted by ADSC and APEX and others in the simulation community, resulted in the creation of an AMCOM Research, Development, and Engineering Center (AMRDEC) Federation Object Model (FOM). The AMRDEC FOM is based on the Real-time Platform-level Reference FOM and contains extensions that address deficiencies and recommend enhancements to evolving standards. These extensions are presented for consideration for possible inclusion in the RPR FOM 3.0 standard.

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I. INTRODUCTION

The U. S. Army's interest in Simulation Based Acquisition is having profound effects in the materiel developer world, most notably in the increased utilization of distributed, real-time simulations interoperating in a common synthetic environment. This reality poses new challenges for the operations researcher and the weapon systems analyst who have a penchant for all-digital constructive (Monte Carlo) simulation. While it is beyond the scope of this report to discuss the relative merits of conducting force effectiveness studies in a Distributed Interactive Simulation/High Level Architecture (DIS/HLA) exercise, the authors of this report have gained a new appreciation for the analytical perspective in real-time exercise monitoring, management, data collection, and analysis.

Recent experiences at the U. S. Army Aviation & Missile Command Research Development and Engineering Center (AMRDEC) and at the U. S. Army Infantry Center and School have highlighted deficiencies within the current DIS and HLA definitions. In conducting the post-test analysis effort for the Rapid Force Projection Initiative Advanced Concept and Technology Demonstration (RFPI ACTD), it was clear that the "fog of war" applied as much to simulated battles as to the real ones. Two limitations were discovered that hampered what could be accomplished in the field experiment: one, there were certain activities (sling loading, for instance) that were common to infantry operations that the DIS protocol did not handle well; and two, there was sub-platform level "truth" data (crew health and status, for instance) that the DIS protocols did not convey at all. The success of the RFPI ACTD was ensured by some creative and innovative work-arounds to these limitations, but the authors contend that a few carefully crafted and selected extensions to the DIS/Real-time Platform Reference (RPR) definition would greatly benefit future simulation activities.

This report presents several proposed modifications to the Real-Time Platform-Level Reference Federation Object Model (RPR-FOM) based upon these experiences. The report discusses several new architectural features outlined in Figure 1 for the community to consider, and concludes with a recommendation for these extensions to be included in the RPR FOM 3.0.

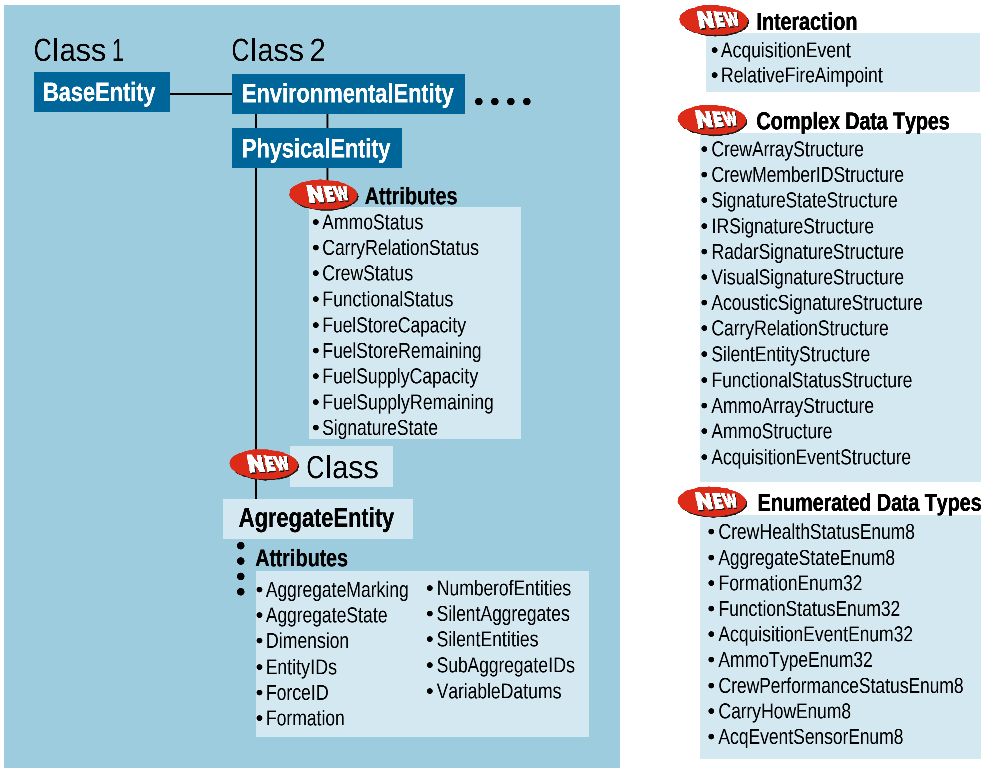

Figure 1. Proposed Modifications to RPR FOM 3.0

II. PROPOSED OBJECT ATTRIBUTES

The platform-level focus of the DIS standard [1], and hence, the RPR FOM [2], is inadequate in force effectiveness analyses. A good example of this is the modern armored personnel carrier, staffed with a crew consisting of a commander, driver, and often a gunner, plus the personnel in transit. The analyst often needs more insight into the status of the crew and load than the basic DIS PDU and RPR FOM class structure allows. This deficiency can be best addressed by the addition of two new attributes in the **PhysicalEntity** object: a **CrewStatus** attribute, which would convey health & status for 1 to N individually identified crew members; and a **CarryRelationStatus** attribute, which would convey “carried by” and “carrying” information (Table 1).

Table 1. Proposed new Physical Entity Attributes

PhysicalEntity
Existing Attributes: • ArticulatedParameters • DamageState • EngineSmokeOn • • • • New Attributes: • CrewStatus • CarryRelationStatus • SignatureState • FunctionalStatus • FuelSupplyCapacity • FuelSupplyRemaining • FuelStoreCapacity • FuelStoreRemaining • AmmoStatus

The **CrewStatus** attribute will contain information about the number of crew members and an enumerated indication of the health and performance of the composite crew, as well as individual members. A typical use of this attribute might be to convey alive/dead/fatigue/… information, which would influence overall system performance.

The **CarryRelationStatus** attribute will bidirectionally capture the current state of carry relationships. This attribute is of most immediate use for assault-type military operations, where equipment is often sling-loaded to an insertion point. There are implications for the **ActionRequest** interaction to facilitate the carry relationships.

The third new attribute proposed for the **PhysicalEntity** object, the **SignatureState** attribute, is intended to provide supplementary information about the signature state that is intended to augment other known static and dynamic signature influences. This proposal only addresses infrared and acoustic signature data, but could conceivably be extended to include other physical phenomenology.

Building upon the legacy of SIMNET, the DIS standard contained five mutually exclusive damage states: undamaged, mobility killed, firepower killed, mobility and firepower killed, and catastrophic killed. These limited states cause frustration to the analyst trying to understand a series of events. A **FunctionalStatus** attribute would include additional states that would not necessarily be mutually exclusive, and would, if applicable, identify the entity responsible for the current state(s). An obvious military application of this attribute would be for an entity under suppression – not in a damaged state, but unable to execute an assigned mission. This attribute could also be of tremendous use to the analyst to assess sub-system and component functional degradations, and in obtaining data for as-yet-undefined non-traditional measures of effectiveness.

In addition to the four attributes mentioned above, there are four more attributes that are proposed to improve the logistics/resupply aspect of interoperating simulations. The **FuelSupplyCapacity**, **FuelSupplyRemaining**, **FuelStoreCapacity**, and **FuelStoreRemaining** attributes would convey information about the capacity and consumption of fuel associated with an entity, both for self-use and resupply of others.

For military platforms, a new **AmmoStatus** attribute is proposed to account for supply and store status, corresponding to ammunition for supply and self-use. Both categories are further defined to allow **n** number of ammunition categories with corresponding **WarHeadType** if applicable as well as total **Capacity** and amount **Remaining**.

Finally, a new/old **AggregateEntity** subclass of **BaseEntity**, completely defined in earlier versions of RPR (0.6 and 2.0), is proposed for retention. The capability to aggregate and de-aggregate in real-time is of tremendous value when conducting brigade-size and larger federation executions. The minimal overhead associated with returning this subclass to the RPR FOM is much more than outweighed by the benefits provided.

The complex and enumerated data types necessitated by these proposals are identified in Figure 1 as well. These definitions are available from the authors upon request.

III. PROPOSED INTERACTIONS

The existing interactions in the RPR FOM do not sufficiently address the need to monitor/report state changes in weapon and sensor systems. These state changes can be categorized as either acquisition events or track events, and are defined in the proposed **AcquisitionEvent** interaction. A target progressing through the various acquisition states (field-of-regard, Field-of-View (FOV), etc.) is independent of the progression through the track states (no track, coast, etc.) (Fig. 2). For each state transition, a corresponding **AcquisitionEvent** interaction would be generated.

Three other interesting points should be made about these interactions. First, that for these events, no presumption can be made about a sequential progression from one state to the next. Second, that in a medium-sized federation execution, there exists a potential for a large number of simultaneous events, hence a significant amount of network traffic can be generated to convey this data. For this reason, considerations have been made to enable or disable these interactions. Third, several “non-acquisition” states (for example, “No Track,” “Field-of-Regard,” “FOV”) have been included to aid the collection of data for target acquisition analysis. This provides critical “denominator” data that has previously been lost.

For the **WeaponFire** interaction, a new parameter called **RelativeFireAimpoint** is proposed to aid the analyst in assessing weapons delivery accuracy. This new parameter is necessitated by weapon systems that are intentionally delivered to a point offset from the aimpoint. Failure to consider this offset can result in skewed analyses, yielding incorrect conclusions on weapon system performance.

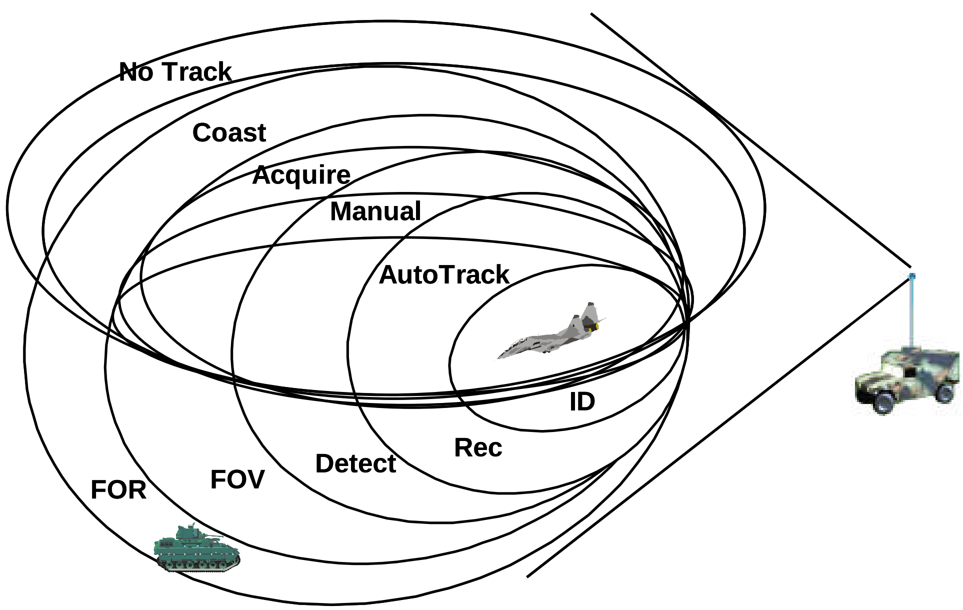

Figure 2. Relative Acquisition and Track States

IV. CONCLUSIONS

All of the attributes and interactions presented in this report have been incorporated into the AMRDEC FOM, which, as a derivative of the RPR FOM, was created to maximize the reuse of legacy DIS models, simulations, tools, and techniques. The authors believe that the inclusion of these extensions to RPR will be of great value to the weapon systems analyst and exercise developer, and will address key deficiencies that pre-date the advent of the HLA. The impact to existing M&S assets will be negligible for federations and federates that have no need for these extensions, and will be minimal for those that do. The AMRDEC FOM is available upon request from the authors.

REFERENCES

1. *IEEE Standard for Distributed Interactive Simulation - Applications Protocols,* IEEE Std 1278.1-1995.

2. *The RPR-FOM - A Reference Federation Object Model To Promote Simulation Interoperability*, Graham C. Shanks, May 5, 1997.

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